

Patent Claims

1. Method of determining the salinity of liquids by standard calibrated measurements of the electrical conductivity of a heated liquid sample in a measuring cell arranged in a constantly cooled and mechanically stirred as well as heatable water bath which is insulated to the exterior under control parametric consideration of the thermal conditions in the water bath characterized by the fact that the actual temperature (ϑ_B) is measured as an equivalent of the temperature (ϑ_P) of the sample with a high repetitive accuracy and inclusion of a maximum permissible lag error ($\Delta\vartheta_{\max}$) between the water bath and sample temperature (ϑ_B , ϑ_P) set by the required accuracy of determining the salinity (S), and that the control parameter for taking into account the thermal conditions is the time-wise drift ($\alpha = \Delta\vartheta_B/t$) of the temperature (ϑ_B) derivable from the temperature measurements, the permissible maximum value (α_{\max}) of which is defined as quotient ($\alpha_{\max} = \Delta\vartheta_{\max}/\tau$) of the maximum permissible lag error ($\Delta\vartheta_{\max}$) and a time constant (τ) of the measuring cell (MC) for a temperature equalization between the interior of the measuring cell and the water bath (WB), whereby the permissible maximum value of the time-wise drift (α_{\max}) of the temperature (ϑ_B) of the water bath is maintained by a low-lag and quickly controllable compensation of the heat currents (P_{\pm}) flowing into and out of the water bath (WB) to such a degree that the resulting quantity of the residual heat current (P_{rest}) does not exceed a predetermined maximum value (P_{restmax}).
2. Measuring method of claim 1, characterized by the fact that the temperature (ϑ_B) of the water bath is maintained with the resultant residual heat current (P_{rest}) at the mean ambient temperature approximately

with a deviation of ± 1 K.

3. Measuring method according to claim 1 or 2,
characterized by the fact that
- 5 the energy input into the water bath (WB) by the stirring (P_R) is also utilized
for the quick and low-lag controllable heating (P_H) thereof.
4. Measuring method according to at least one of claims 1 to 3,
characterized by the fact that
- 10 the heat resistance (R) of the exterior insulation (I) of the water bath (WB) is
high.
5. Measuring method according to at least one of claims 1 to 4,
characterized by the fact that
- 15 the heat resistance (R) of the water bath cooling (PE) on the side of the bath
is high.
6. Measuring method according to at least one of claims 1 to 5,
characterized by the fact that
- 20 that the temperature of the liquid sample (ϑ_p) is adjusted to the temperature
(ϑ_b) of the water bath in a separately controlled advance bath (PB).
7. Measuring method according to at least one of claims 1 to 6
characterized by the fact that
- 25 the measuring sequence is carried out automatically by a computer (PC) and
that the salinity (S) of the liquid sample (PROBE) is calculated from the
measured values of temperature (ϑ_b) and conductivity (κ) on the basis of the
UNESCO formula.
- 30 8. Apparatus for practicing the method according to at least one of claims
1 to 8 of determining the salinity of liquids by standard calibrated

measurements of the electrical conductivity of a heated liquid sample which may be transferred from a sample vial into a measuring cell arranged in a water bath provided with a cooling, a stirring and a heating element as well as with a heat exchanger and provided at its wall with an external insulation and

5 a control device in which the actual temperature (ϑ_b) of the water bath is measured with high repetitive accuracy and including a maximum permissible lag error ($\Delta\vartheta_{max}$) between the water bath and sample temperature (ϑ_b , ϑ_p) determined by the accuracy demanded in by the determination of salinity (S) as the equivalent of the temperature (ϑ_p) of the sample and wherein the

10 control parameter for taking into account the thermal conditions is the time-wise drift ($\alpha = \Delta\vartheta_b/t$) of the temperature (ϑ_b) of the water bath the permissible maximum value (α_{max}) of which is defined as quotient ($\alpha = \Delta\vartheta_{max}/\tau$) of the maximum permissible lag error ($\Delta\vartheta_{max}$) and a time constant (τ) of the measuring cell (MC) for a temperature balancing between the interior of the

15 measuring cell and the water bath (WB), whereby the permissible maximum value of the time-wise drift (α_{max}) of the temperature (ϑ_b) of the water bath is maintained to such a degree by a low-lag and quick controllable adjustment of the heat currents (P_{\pm}) flowing into and out of the water bath (WB) that the quantity of the resulting residual heat current (P_{rest}) does not exceed a

20 corresponding predetermined maximum value ($P_{restmax}$), whereby for the direct measurement of the actual temperature ($\Delta\vartheta_b$) of the water bath there is provided in the water bath a precision thermometer (TM) having a long term stability of less than 1 K per year and a time constant of less the .5 s.

25 9. Measuring apparatus of claim 8, characterized by the fact that the precision thermometer (TM) is provided with temperature dependent semiconductor resistors.

30 10. Measuring apparatus according to claim 8 or 9, characterized by the fact that

the stirrer provided for stirring and heating the water bath (WB) is structured as a rotationally controllable stirring propeller (Q) having a stirring vane (SP) similar to a ship's screw of high hydrodynamic efficiency which is drivable by a continuously controllable electric motor (EM) arranged at the exterior of the water bath (WB).

11. Measuring apparatus according to at least one of claims 8 to 10, characterized by the fact that that in the wall of the water bath (WB) there is arranged at least one Peltier element (PE) provided with a thermal insulation (I) at the cooling side of the water bath (WB).

12. Measuring apparatus according to at least one of claims 8 to 11, characterized by the fact that the measuring cell (MC) has a volume in the range of 2 ml and is provided with strip electrodes (SE).

13. Measuring apparatus according to at least one of claims 8 to 12, characterized by the fact that that for heating the liquid sample (PROBE) there is provided a separate controllable advance bath (PB) provided with a preheat exchanger (PWT).

14. Measuring apparatus according to at least one of claims 8 to 13, characterized by the fact that for carrying out standard calibrations and measurements there is provided a four-way valve (FV) provided with inputs to a vial (A) of standard sea water (SSW), to a bottle (B) of sample water (PROBE) as well as to a cleaning and an air conduit (H₂O, Air).

15. Measuring apparatus according to at least one of claims 8 to 14, characterized by the fact that

for evacuating the measuring cell (MC) there is provided a diaphragm pump (MP).

16. Measuring apparatus according to at least one of claims 8 to 15,
5 characterized by the fact that
for filling the measuring cell (MC) there is provided a dosage pump (DP).

17. Measuring apparatus according to at least one of claims 8 to 16,
characterized by the fact that
10 a computer (PC) is provided for regulating the water bath, controlling the
measuring sequence, and storing results.

18. Measuring apparatus according to at least one of claims 8 to 17,
characterized by the fact that
15 that the conductivity measurement of the liquid sample (PROBE) is carried
out at a fully automatically balancing precision bridge.

19. Measuring apparatus according to at least one of claims 8 to 18,
characterized by the fact that
20 there is provided an indicator of satisfied measuring conditions.

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